GERTSIBANDE DISTRICT

MKHONDO EAST, WEST & AMSTERDAM CIRCUITS

GRADE 12

PHYSICAL SCIENCES TOPIC TEST

MARCH 2021

VERTICLE PROJECTILE MOTION

MARKS: 50

TIME: 1:00 HOUR

This question paper consists of 6 pages including the data sheet

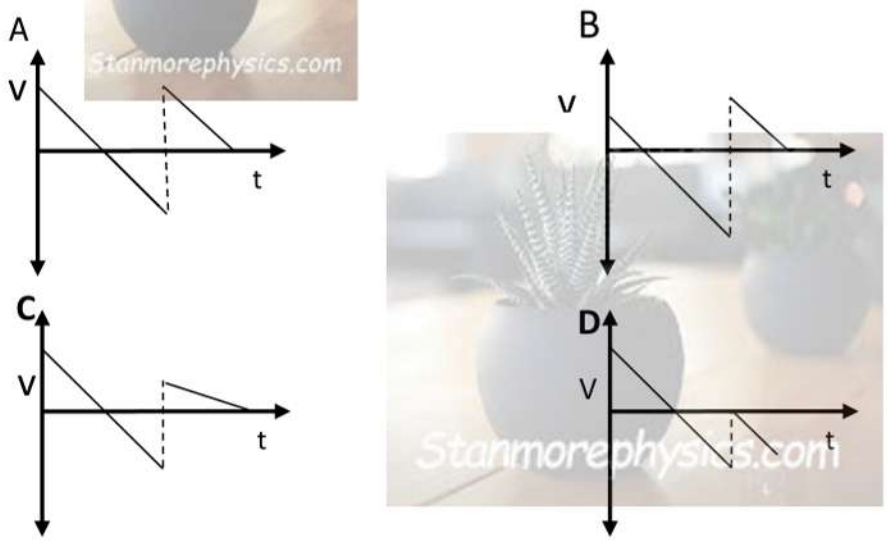
INSTRUCRIONS AND INFORMATION

1. Answer ALL questions.
2. Number all your questions correctly.
3. You are advised to use the attached DATA SHEET.
4. Write neatly and legibly.

QUESTION 1

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A-D) next to the question number (1.1- 1.3) in the answer sheet, eg. 1.1 A.

1.1 A ball is projected vertically upwards from the ground. It returns to the ground, makes an elastic collision with the ground and then bounces to a maximum height. Ignore air resistance. Which ONE of the following velocity-time graphs CORRECTLY describes the motion of the ball?



(2)

1.2 The statements below describe the motion of objects.

(i) A feather falls from a certain height inside a vacuum tube.
(ii) A box slides along a smooth horizontal surface at constant speed.
(iii) A steel ball falls through air in the absence of air friction.

Which of the following describes UNIFORMLY ACCELERATED motion CORRECTLY?

A (i) and (ii) only
B (i) and (iii) only
C (ii) and (iii) only
D (i), (ii) and (iii) (2)

1.3 An object is thrown vertically upwards. Which ONE of the following regarding the object's velocity and acceleration at the highest point of its motion is CORRECT? Ignore the effects of friction.

	VELOCITY	ACCELERATION
A	Zero	Zero
B	Zero	Upwards
C	Maximum	Zero
D	Zero	Downwards

(2)
[6]

QUESTION 2

A boy projects a ball of mass 0, 5 kg vertically downwards towards the ground from a height of 1,8m at a velocity of 8 $m \cdot s^{-1}$.
The ball is in contact with the floor for 0, 01 s. Ignore the effects of air friction.

2.1 The boy claims that the ball was in a free fall directly after he projected it. Do you AGREE or DISAGREE with his statement?
Give a reason for your answer. (2)

2.2 Draw a free body diagram for an object in free fall. (1)

2.3 Write down the magnitude and direction of the acceleration of the ball immediately after it is projected. (1)

2.4 Calculate:
2.4.1 The magnitude of the velocity with which the ball hits the ground. (4)

2.4.2 The time it takes the ball to hit the ground. (3)
2.4.3 The net force exerted by the ball on the ground. (3)

2.5 Sketch an acceleration-time graph for the motion of the ball (no values required) (2)
[16]

QUESTION 3

The diagram below shows the motion of a stone that is thrown vertically upwards from the roof of a 5,83m high building at a velocity of 4, 9 $m.s^{-1}$. After reaching the highest point above the roof, it falls past the roof and strikes the ground after 1,7s from the start of its motion.

3.1 Define the term projectile. (2)

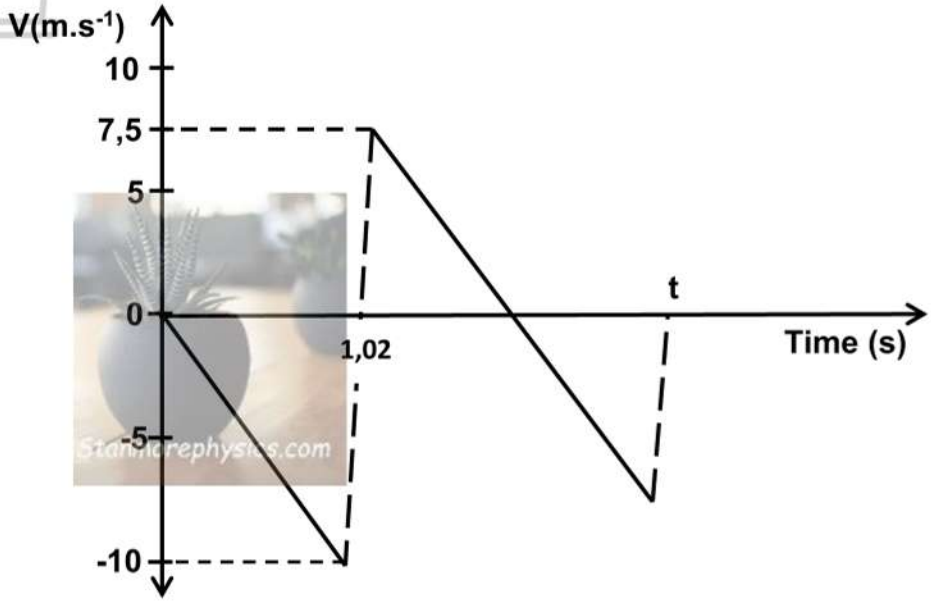
3.2 Calculate, using the equations of motion;
3.2.1 The time taken for stone to reach its maximum height. (3)
3.2.2 The velocity with which the stone reaches the ground. (3)
3.2.3 The maximum height the stone reached **above the ground**. (3)

3.3 Sketch a velocity-time graph for the motion of the stone, from the time the stone is thrown until it hits the ground.
Clearly show the following on the graph:
- The initial velocity of the stone.
- The velocity and time when the stone hits the ground.
- The time taken by the stone to reach the maximum height. (4)

[15]

QUESTION 4

A ball of mass 0, 2 kg is dropped vertically downwards from the top of a building to a concrete floor below. The ball bounces off the floor. The velocity versus time graph below shows the motion of the ball. Ignore the effects of air friction. TAKE DOWNWARD MOTION AS NEGATIVE.



4.1 Use the graph **only**:

4.1.1 To determine the number of times the ball bounces off the floor. (1)

4.1.2 To determine whether the collision between the ball and the floor is elastic or inelastic. Provide a reason for your answer. (2)

4.1.3 To calculate the height from which the ball is dropped. (3)

4.2 Calculate the impulse that the ball exerted on the floor when it struck the floor for the first time. (3)

4.3 Sketch a POSITION versus TIME graph for the motion of the ball from the moment it was dropped until time **t**. USE THE POINT WHERE THE BALL FELL FROM (i.e. the top of the building), AS THE ZERO POSITION.

Indicate the following on the graph:
- The height from which the ball is thrown
- Time t (4)

[13]

TOTAL: 50

DATA FOR PHYSICAL SCIENCES P1 GRADE 12

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9,8\ m{\cdot}s^{-2}$

TABLE 2: MOTION

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$ or $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$

TABLE 3: FORCE

$F_{net} = ma$	$p = mv$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$

TABLE 4: ENERGY

$K = \frac{1}{2}mv^2$ or $E_k = \frac{1}{2}mv^2$ $E_P = mgh$ or $U = mgh$	$\Delta K = K_f - K_i$ or $\Delta E_k = E_{kf} - E_k$

GERTSIBANDE DISTRICT

MKHONDO EAST, WEST & AMSTERDAM CIRCUITS

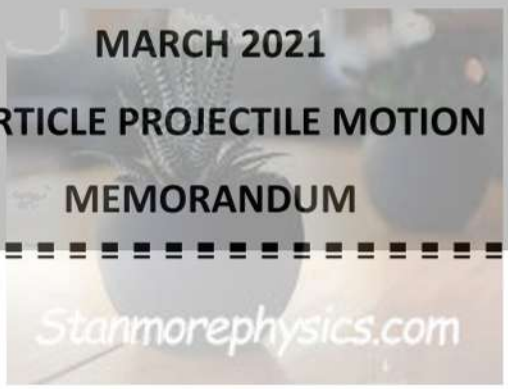
GRADE 12

PHYSICAL SCIENCES TOPIC TEST

MARCH 2021

VERTICLE PROJECTILE MOTION

MEMORANDUM



MARKS: 50

This memorandum consists of 6 pages

QUESTION 1

1.1 A✓✓ (2)

1.2 B✓✓ (2)

1.3 D✓✓ (2)

[6]

QUESTION 2

2.1 Yes; ✓ It is under the influence of gravitational force only✓ (2)

2.2

✓ (1)

2.3 9,8 $m.s^{-2}$ down ward ✓ (1)

2.4.1

Downwards positive: **OPTION 1** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= 8^2$ ✓ $+ \underline{2(9,8)(1,8)}$ ✓ $v_f = 9,96\ m{\cdot}s^{-1}$ ✓	**Upwards positive:** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= (-8)^2$ ✓$+ \underline{2(-9,8)(-1,8)}$ ✓ $v_f = 9,96\ m{\cdot}s^{-1}$ ✓	
OPTION 2 $(mgh + \frac{1}{2}mv^2)_{top} = (mgh + \frac{1}{2}mv^2)_{floor}$ ✓ $\underline{m(9,8)(1,8) + \frac{1}{2}m(8)^2}$ ✓ $= \underline{0 + \frac{1}{2}mv^2}$ ✓ $17,64 + \frac{1}{2}(64) = \frac{1}{2}v^2$ $v = 9,96\ m{\cdot}s^{-1}$ ✓	**OPTION 3** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\underline{1,8 = 8\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓ $\Delta t = 0,2\ s$ Both Formulae ✓ $v_f = v_i + a\Delta t$ $= \underline{8 + (9,8)(0,2)}$ ✓ $v_f = 9,96\ m{\cdot}s^{-1}$ ✓	(4)

2.4.2

POSITIVE MARKING FROM **Q 2.4.1** **OPTION 1** **Downwards positive:** $v_f = v_i + a\Delta t$ ✓ $\underline{9,96 = 8 + 9,8\Delta t}$ ✓ $\Delta t = 0,2\ s$ ✓ **Upwards positive:** $v_f = v_i + a\Delta t$ ✓ $\underline{-9,96 = -8 + (-9,8)\Delta t}$ ✓	**OPTION 2** **Downwards positive:** $\Delta y = \frac{v_f + v_i}{2}\Delta t$ ✓ $1,8 = \frac{9,96+8}{2}\Delta t$ ✓ $\Delta t = 0,2\ s$ ✓ **Upwards positive:** $\Delta y = \frac{v_f + v_i}{2}\Delta t$ ✓ $-1,8 = \frac{-9,96+(-8)}{2}\Delta t$ ✓

$\Delta t = 0,2$ s ✓	$\Delta t = 0,2$ s ✓
OPTION 3 **Downwards positive:** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\underline{1,8 = 8\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓ $\Delta t = 0,2$ s ✓ **Upwnwards positive:** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\underline{-1,8 = (-8)\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓ $\Delta t = 0,2$ s ✓	

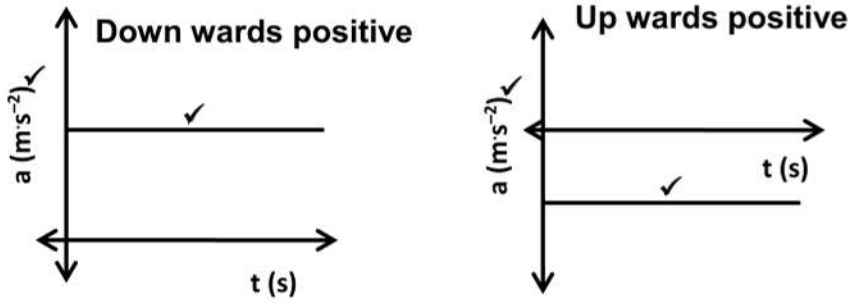
(3)

2.4.3 $F_{net}\,\Delta t = \Delta P$✓

$F_{net}\,(0,01) = 0,5(\,9,96 - 8)$ ✓

$F_{net} = 98$ N✓ (3)

2.5



(2)

[16]

QUESTION 3

3.1 An object upon which the <u>only</u> force acting is the force of Gravity.✓ ✓ **(2 or 0)**

ACCEPT:

- An object that falls freely with an acceleration of 9, 8m.s^{-2}.
- An object that is launched with an initial velocity under the influence of the force of gravity <u>only.</u>

(2)

3.2.1 **Upwards positive:**

Upwards positive:	**Down wards positive:**
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓

$0 = 4,9 + (-9,8)\Delta t$ ✓ $\Delta t = 0,5$ s ✓	$0 = -4,9 + (9,8)\Delta t$ ✓ $\Delta t = 0,5$ s ✓

(3)

3.2.2

Upwards positive:	**Down wards positive:**
$v_f = v_i + a\Delta t$ ✓ $= \underline{4,9 + (-9,8)\ (1,7)}$ ✓ $= 11,76\ m{\cdot}s^{-1}$ ✓	$v_f = v_i + a\Delta t$ $= \underline{-4,9 + (9,8)\ (1,7)}$ ✓ $= 11,76\ m{\cdot}s^{-1}$ ✓

(3)

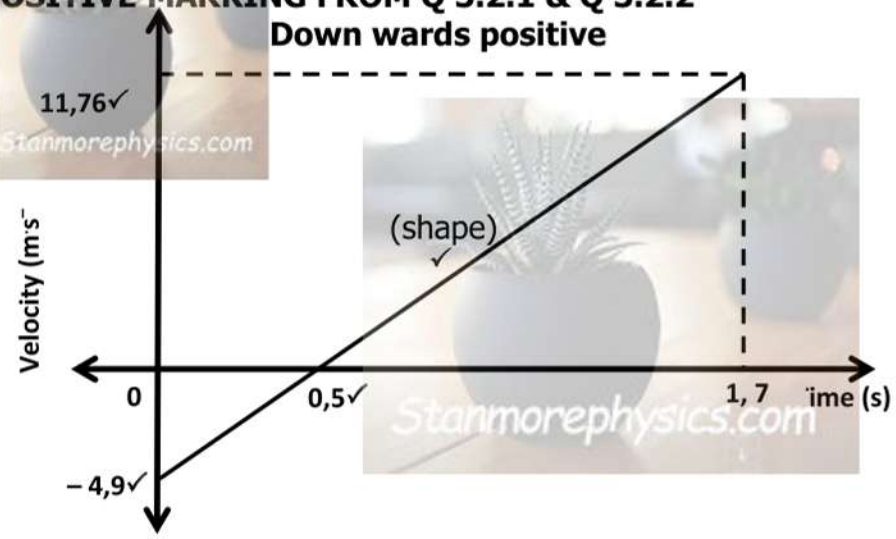
3.2.3

Upwards positive: **OPTION 1**	**Down wards positive:** **OPTION 1**
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= 4,9(0,5) + \frac{1}{2}(-9,8)(0,5)^2$ ✓ $\Delta y = 1,225$ m (above the starting point) $\Delta y = 1,225$ m $+5,83 = 7,055$m ✓ (Above the ground)	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= -4,9(0,5) + \frac{1}{2}(9,8)(0,5)^2$ ✓ $\Delta y = -1,225$ m $\Delta y = 1,225$ m (above the starting point) $\Delta y = 1,225$ m $+5,83 = 7,055$m ✓ (Above the ground)
OPTION 2 $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = (4,9)^2 + 2(-9,8)\ \Delta y$ ✓ $\Delta y = 1,225$ m(above the starting point) $\Delta y = 1,225$ m $+5,83 = 7,055$m ✓ (Above the ground)	**OPTION 2** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = (-4,9)^2 + 2(9,8)\ \Delta y$ ✓ $\Delta y = -1,225$ m $\Delta y = 1,225$ m (above the starting point) $\Delta y = 1,225$ m $+5,83 = 7,055$m ✓ (Above the ground)
OPTION 3 $\Delta y = \frac{(v_f + v_i)}{2}\Delta t$ ✓ $= \frac{0+4,9}{2}(0,5)$ ✓ $\Delta y = 1,225$ m(above the starting point) $\Delta y = 1,225$ m $+5,83 = 7,055$m ✓	**OPTION 3** $\Delta y = \frac{(v_f + v_i)}{2}\Delta t$ ✓

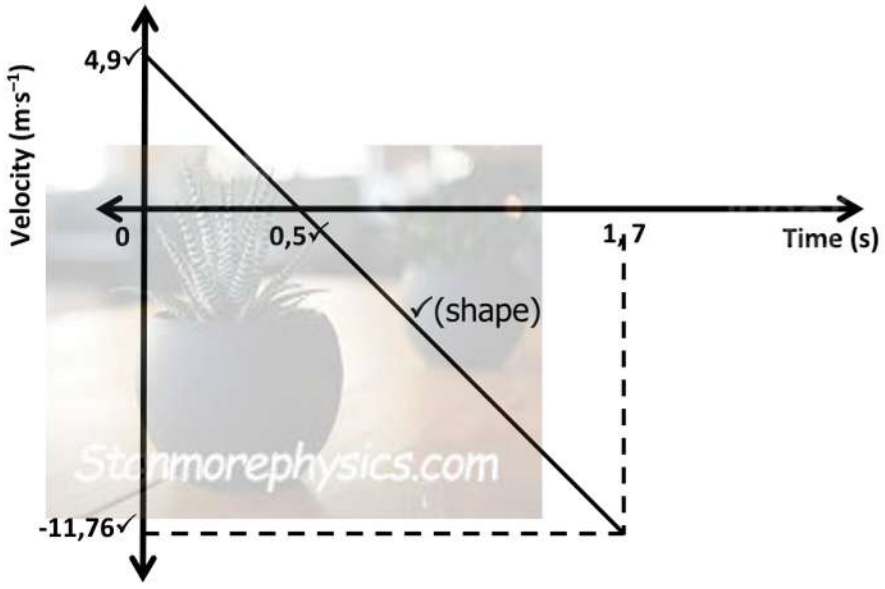
(Above the ground)	$= \frac{0+(-4,9)}{2}(0,5)$ ✓ Δy = -1,225 m Δy = 1, 225 m (above the starting point) Δy = 1, 225 m +5, 83 = 7, 055m✓ (Above the ground)

3.3 **POSITIVE MARKING FROM Q 3.2.1 & Q 3.2.2**

Down wards positive



Up wards positive



(4)
[15]

QUESTION 4

4.1.1 1/one✓ (1)

4.1.2 inelastic ✓

The velocity (7, 5 cm^{-1}) at which the ball bounces off the floor is less than the velocity (10m.s^{-1}) at which it hits the floor. ✓
OR: There is a decrease/change in velocity then the ball hits the floor. (2)
OR: There is a change/decrease in kinetic energy due to the change/decrease in the velocity when the ball hits the floor

4.1.3 $\Delta Y = \frac{1}{2}$ X b x h✓
= 0,5 x 1,02 x(-10) ✓
= -5,1m
= 5,1m✓ (3)

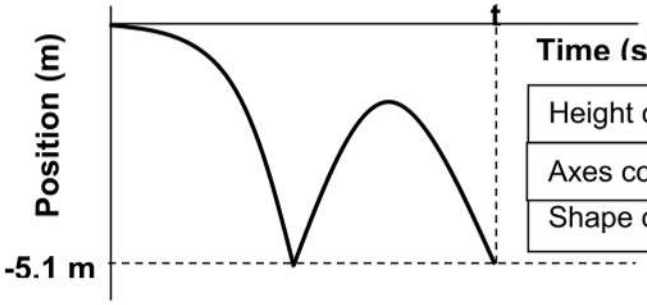
4.2 **OPTION 1**

$F\Delta t_{floor\ on\ ball}$ = $m(v_f - v_i)$✓
= (0,2)(7,5 – (-10)) ✓
= 3,5 Ns
∴ $F\Delta t_{ball\ on\ floor}$ = -3,5 Ns
= 3,5 Ns downwards✓

OPTION 2

$F\Delta t_{ball\ on\ floor}$ = $m(v_f - v_i)$✓
= (0,2)(-7,5 – 10) ✓
= -3,5 Ns
$F\Delta t_{ball\ on\ floor}$ = 3,5 N downwards✓ (3)

4.3 **POSITIVE MARKING FROM Q 4.1.3**



Height of building (-5,1m)	1 mk
Axes correctly labelled	1 mk
Shape of each curve:	2 mrks

(4)
[13]

TOTAL:50